LABORATORY EXAMINATION OF SURFACE ROUGHNESS AND WEIGHT LOSS OF TWO TYPES OF CONVENTIONAL COMPOSITES (GRANDIO AND TETRIC N CERAM) AND BULK FILL (X-TRA FILL AND TETRIC N CERAM BULK FILL) AFTER TOOTHBRUSHING TEST

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Abstract. Introduction: The long-term clinical success of composite materials depends on physical and chemical properties such as surface smoothness and preservation of integrity in the oral environment. The aim of this study was to evaluate the surface roughness and weight loss of two types of bulk fill and conventional composites (Tetric N Ceram and Grandio) and Tetric N Ceram and X-tra fill after a Toothbrushing Test. **Method:** In this experimental study, 28 disc shaped samples (7 samples of each composite) were made using a two-piece metal cylinder (in thickness of 2 mm and 10 mm in diameter). Each composite sample from the upper part was overlap cured by the manufacturer in accordance with the manufacturer's instructions. At first, initial surface roughness was measured by the prophylometric machine and the initial weights of the samples were measured by a digital scale. The specimens were then abrasive in the Toothbrushing Test machine with 2000 cycles. After this stage, the secondary surface roughness and the weight of the specimens were re-measured. Data analysis was performed using SPSS software version 20 and data were analyzed by two way ANONA and Tukey test and a significant level of P <0.05 was determined. **Results:** Tetric N Ceram bulk fill composites showed the highest and granitic composites showed the slightest surface roughnessafter the Toothbrushing Test. Compared to conventional and bulk fill composites, the highest increase in was observed in Balkh composites. **Conclusion:** The results of this study indicate that surface roughnessin bulk fill composites after brushing is more than conventional types. The size of the filler and the size of the filler particles are also the variables that affect on the superficial violence.

Keywords: composite, Bulk fill, loss weight, superficial violence.

Introduction: Dentists choose resins composite for reasons such as beauty, strength, lower cost than ceramics, and adhesive to dental structures. Of course, polymerization contraction, abrasion and color ability potentials, are the disadvantages of these materials. Many techniques have been suggested to reduce the negative effects of composite polymerization contraction in posterior restorations, including composite placement, by using bracer stress liner and changing in photo initiation mechanism (1-3). Although the layered method is a standard way to repair large cavities, this method also has some disadvantages, including time consuming and increasing the risk of air entering and creating bubbles and contamination between layers. Problems caused by the use of conventional composites in large cavities repair, as well as the disadvantages of composite layered method, have led coliniscin to find simpler and faster repair methods (8-4). One of these new techniques is the Bulk fill technique, which recently introduced composites for this technique to the dental market. These composites have the ability to have a thickness of 4 mm, while mechanical properties, cure depth and edge alignment and degree of conversion are appropriate. By using these composites, the number of layers is reduced to repair large cavities, and the process of repairing is easier and the clinical work time is reduced (13-9). The long-term durability of composite restorations in the variable oral environment depends on the inherent characteristics of the material and resistance to the chemical and mechanical changes of the oral cavity. Many of the composites properties such as superficial violence, water absorption and solubility are important factors affecting their clinical performance (14,15). Surface irritation is one of the important properties that, in addition to the repair appearance, affects their biological properties and their clinical lifespan. It has been noticed that the durability of the restorations with a smoother surface is greater, as well as a smooth surface that improves beauty, reduces the accumulation of plaque and color, and also reduces the inflammation of surrounding soft tissue. The superficial violence of a composite depends on its chemical formula, filler content, size and shape of the filler particles, the space between the particles, the type of monomer, the degree of conversion, and the quality

of the connection of the filler particles to the resin matrix. On the other hand, external factors in the oral environment such as parafunction habits, brushing with abrasive particles, jaw repair site and also chemical agents in the oral environment affects the surface properties of composite restorations and the degree of their surface roughness change (16-21). Surface roughness more than 0.2 microns increases plaque accumulation significantly.

A smooth surface makes the patient more comfortable and according to various studies, surface violence is more than 0.5 microns felt by the patient's language (22-24). Toothbrushing is the most common and effective mechanical removal method for dental biofilm, but the same procedure, if repeated, and the addition of abrasive particles can cause abrasion of the tooth structure and the level of composite restorations resulting in increased surface roughness and subsequent problems (25-27). Surface roughness can lead to increased microbial plaque absorption and staining of the restorative material, and Surface roughness affects the aesthetic properties of the composite, including reflection of light, color and translucency (28). Junior et al. in 2015 performed a study to examine the surface roughness of some composites(P90, Z350, Opallis, Grandio) With different types of polish (with diamond pro, super fix, polidores DFL, Enhance, sof-lex).

The results of their study showed that composites with the highest percentage of filler, showed the least surface violence after any kind of purification. In addition, the Grandio Composite with 85% volumetric filler showed the lowest surface violence after applying various polishing agents (29). Considering that the identification of composites with high resistance to abrasion can help to select the best material for teeth restoration and improve long-term clinical efficacy and preserve aesthetic and original gloss, Also, with the introduction of bulk fill composites to repair posterior teeth and the necessity of resistance of these materials against occlusal forces and abrasion of food particles, it was necessary to investigate them to determine physical and chemical characteristics. Therefore, considering that the surface roughness of this material has not been studied extensively, we have investigated this study with the aim of investigating the chemistry and filler types in some of the common conventional composite and bulk fill, the effect of Toothbrushing Test on the level of surface roughness and loss their weight, so that they can help with the selection of the best material in restoring the types of teeth.

Materials and Methods:

In this experimental study, 28 disc shaped samples (7 samples from each composite) were made using a two-piece metallic generator (thickness of 2 mm and diameter 10 mm). To produce composite specimens, a metal producer placed on a glass slab was filled in one place in a thickness of 2 mm with composite and covered with a second glass slab and topped over and overlapped cured according to the order of the factory. The light cure apparatus Optilux 50l used in this study (Kerr, USA), with a minimum intensity of 650 2mw / cm, the head diameter of 11 mm, and the intensity of the device were periodically evaluated by the radiometer of the device itself. Samples were polished with silicon carbide 600 and 800 grait in a machine (Iran / Malek Tab), then under cold water and then polished to remove resin-rich layer.

Finishing and testing of composite specimens in wet conditions was performed to ensure that the conditions for testing were closer to clinical conditions, and probability of harmful effects of payment in a dry environment, such as fine cracks, decreased. Samples were stored for 24 hours in a water bath of 37 ± 1 °C to complete polymerization, after which the samples were washed in water for 1 minute and dried with tissue paper and were evaluated for determination of primary surface roughness by Profilometere (TIME group / TR200 / USA). In each sample, 3 areas were evaluated for surface violence, and their average was recorded as surface roughness(Ra) in micro-meters. After this stage, the samples were placed in distilled water at 37 ± 1 ° C in the incubator (Iran / kavosh mega) for 2 hours and at 23 ± 1 ° C in the desiccator. The weight of each specimen was measured daily by digital scales (AND, CR 202 / Japan).

When the weight of the specimens was the same for two consecutive days (with a difference with less than 0.5 mg), that number was recorded as the initial weight, this stage lasted for 17 days. Next, samples of each separate group were mounted on a Toothbrushing Test machine (Iran / Spadana, Isfahan), and at 2 cycles per second, 20,000 cycles equivalent to 2 years brushing with Oral-B toothbrushes with moderate nylon bristles, in a solution composed of 50 gr Crest toothpastes (compete 7) were washed in 100 ml of distilled water. The reason for the selection of 20,000 cycles was based on the study of articles, and that in cycles above 20,000 the rates of abrasion were fixed or reduced (30, 31). After the Toothbrushing Test, the samples were removed and washed under water for 1 minute, dried with tissue and their secondary surface roughness measured by prophilometer with 0.5 mm / second speed and with 4 millions force and a length of 4 mm in 3 area of measurement and their average were calculated. The cut off (control) value was 0.3 mm (32). To measure the secondary weight, the samples were again kept in distilled water at 37 ± 1 ° C for 22 hours and 2 hours in a desiccator at 23 ± 1 ° C, each day, the weight of the specimens was measured to achieve a stability, which lasted 10 days. The composition of the following composites examined in the study (Table 1)

Table 1. Combination of composites that examined in the study

Composite	Type	Manufacture	Batch no	Composition
Grandio	Conventional	Voco Euxhaven Germany	1349433	Bis-GMA/TEGDMA UDMA M Barium _ Boron_ Alamino_ Silicat glass 0.1-2.5ɱm 87%w
X-tra fill	Bulk fill	Voco Euxhaven Germany	1618416	Bis-GMA/TEGDMA / UDMA Barium _ Boron_ Alamino_ Silicat glass 2-3 ɱm 87%w
Tetnic N Ceram	Conventional	Ivoclar _ Vivadent Schaan Liechtenstein	U13292	Bis-GMA/ UDMA Bis-EMA TEGDMA Barium glass/ Ytt erbium di fluoride (Yb3f) 0.4-3 ɱm 81%w
Tetric N Ceram Bulk fill	Bulk fill	Ivaclar _ Vivadent Schaan Liechtenstein	U03089	Bis-GMA/ UDMA Bis- EMA Barium glass Prepolymerized filler Monomer , glass filler , Ytterbium fluoride sphericad Mixedozide 77%w

Two-Way ANOVA (ANOVA) and Tukey follow-up tests were used to compare the composites and paired t-test to compare the variables before and after the Toothbrushing Test. P value less than 0.05 was considered as statically significant difference. Normal tests were performed to ensure the normal distribution of data, there was evidence that data was normal, therefore, parametric tests were used (Kolmogorov-Smirnov test). Finally, the data were analyzed using SPSS version 20 software.

Findings:

In this study, from each composite, 7 samples were made in the form of discs with a diameter of 10 mm and height 2 mm using a two-piece metallic generator. A total of 28 samples were prepared for evaluation in this study. According to the results and Table 1, the primary surface roughness of the Grandio composite was the most common, and the Tetric N Ceram composite primary surface roughness was the least. Surface roughness of composites before tooth brushing is shown in Table2.

Table 2 . Average surface roughness of 4 composites before Toothbrushing Test

Surface Roughness (Ra)	Average	Standard deviation	Maximum	Minimum
Grandio	0.440	0.032	0.502	0.412
X-tra fill	0.437	0.027	0.486	0.406
Tetric N Ceram	0.143	0.011	0.158	0.126
Tetric N Ceram bulk fill	0.190	0.004	0.198	0.183

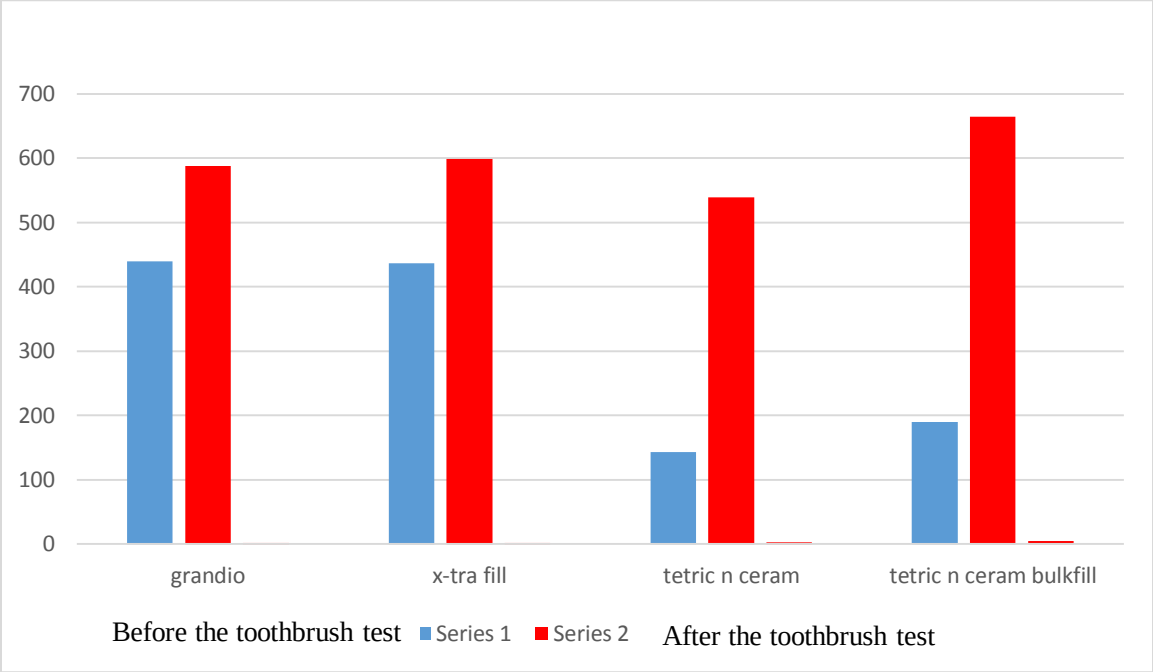

Figure 1: Disturbance of surface 4 composite before and after the toothbrush test

According to Table 2, the results of secondary surface roughness Tetric N Ceram composite was the least after the Toothbrushing Test, and the secondary surface roughness of the Tetric N Ceram bulk fill composite was even higher after the Toothbrushing Test. surface roughness of composites after Toothbrushing Test is shown in Table 3.

Table 3 . Average surface roughness of 4 Composites after Toothbrushing Testing

Surface Roughness (Ra)	Average	Standard deviation	Maximum	Minimum
Grandio	0/588	0/066	0/660	0/496
X-tra fill	0/599	0/048	0/673	0/531
Tetric N Ceram	0/539	0/038	0/616	0/506
Tetric N Ceram bulk fill	0/664	0/051	0/754	0/623

According to the results, the difference in surface roughness of 4 composites before and after the Toothbrushing Test showed that the increase in surface roughness in the Grandio composite was the least and the increase in surface roughness after the Toothbrushing Test in the Tetric N Ceram bulk fill composite was higher than others. According to the results of the study, it was determined that the surface roughness of all four composites increased after the Toothbrushing Test, the weight of each composite after the Toothbrushing Test was reduced. Also, the increase of superficial violence in bulk fill composites was more than conventional ones, and these changes were statistically significant.

According to Table 3 and the results, the weight of the Grandio was even higher before the Toothbrushing Test. In Table 3, the average of initial weight in 4 composites is observed before the Toothbrushing Test.

Table 4. Average of initial weight in 4 Composite before tooth brushing

Weight (mg)	Average	Standard deviation	Maximum	Minimum
Grandio	412/9	5/20	420/3	404/6
X-tra fill	421/2	4/78	427/8	414/6
Tetric N Ceram	423/3	3/94	428/2	417/9
Tetric N Ceram bulk fill	423/7	4/28	429/5	417/9

According to Table 4 and results, the initial weight of the X-tra fill was the highest after the Toothbrushing Test. In Table 4, the average of secondary weight in 4 composite is observed after the Toothbrushing Test.

Table 5. Average Secondary Weight of Composite 4 after Toothbrushing Test.

Weight (mg)	Average	Standard deviation	Maximum	Minimum
Grandio	409/5	4/79	416/2	401/1
X-tra fill	416/6	4/73	423/3	409/6
Tetric N Ceram	404/8	4/92	421/3	406/8
Tetric N Ceram bulk fill	413/9	3/16	417/2	409/2

According to the results obtained from the weight difference of 4 composites before and after the Toothbrushing Test, it was found that the highest weight loss was attributed to the Tetric N Ceram bulk fill composite and the lowest weight loss associated with the Grandio composite (Figure 1).

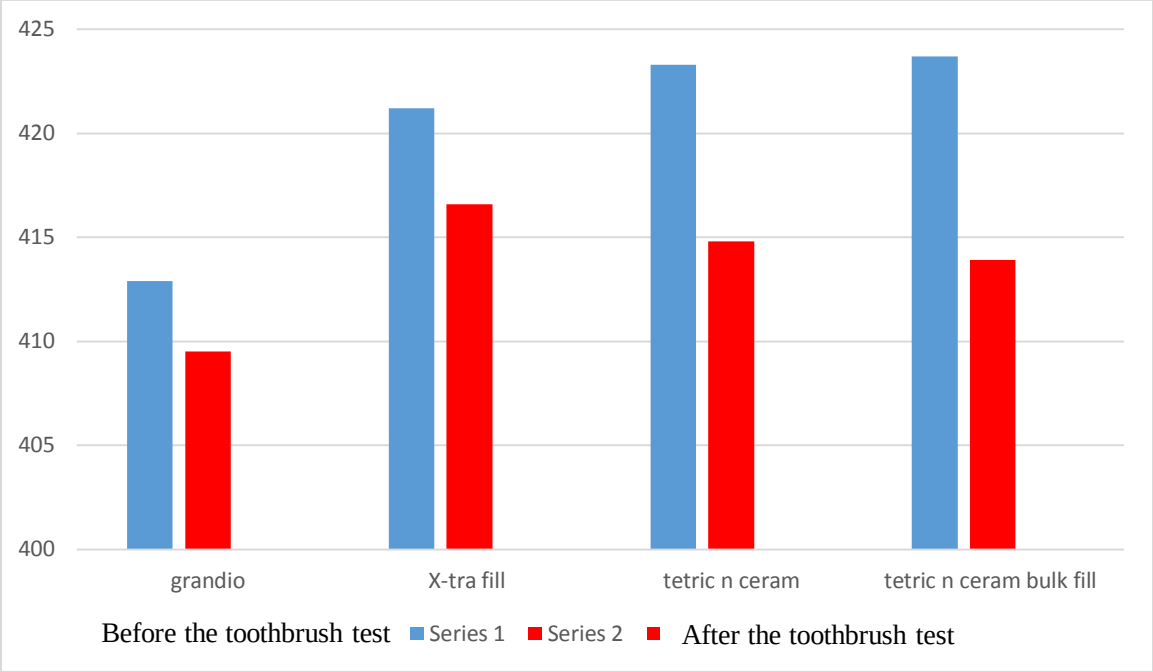

Figure 2: Weight difference of 4 Composite before and after the Toothbrushing Test

Discussion & Conclusion:

In the oral cavity, the surfaces of restorative materials are exposed to a lot of chemical and mechanical factors that can alter their surface properties.

Abrasion because of tooth brush test can occur in restorative materials that are present at any of the dental surfaces, but occurs at the buccal level and class 5 and 4 restorations more than the rest of the levels. The occlusal part of the restorations, are also under the abrasion of the front tooth, the abrasive particles of food during chewing action and abrasion caused by the toothbrush (34,33). Toothbrush plays an important role in this, tooth brushing with fluoride toothpaste helps to reduce dental caries, but with increased use of toothbrush throughout the day and the use of abrasive particles can also be a side effect like changing in the surface properties of dental tissue and restorative materials. Toothbrushing Test is a fast, effective and valid method for assessing the abrasion and surface roughness of composites under standard conditions (22,23). The results of this study showed that the highest surface roughness after the Toothbrushing Test was related to Tetric N Ceram bulk fill and the lowest surface roughness was related to Tetric N Ceram. In comparison, surface roughness of the samples before and after the Toothbrushing Test showed that slightest increase in surface roughness associated with the Grandio composite and the highest increase was related to Tetric N Ceram.

In a study by Magdaleng et al. in 2015, it was shown that composites with high percentage of Filler exhibit more surface roughness after two or three bodily abrasions, which is consistent with the result of this study (35). In a study by Junior et al. in 2015, they compared the superficial violence of the Grandio, Opallis, Z350 and P90 composites after using different polishing tools, the results of their study also showed that the least surface roughness was due to the Grandio composite, which had the highest filler volume compared to other composites studied (36-38). Mondelli et al. (2005) studied the weight loss and surface roughness of some composite and compomers after a Toothbrushing Test. Their results showed that all 7 composites and compomers after tooth brushing had increased levels of surface roughness and weight loss, although these changes in the compomers were higher, and this could be attributed to their lower filler percentages (30).

Compared to conventional and bulk fill composites of each company, individually, the highest surface roughness was observed in Bulk fill composites company. However, this difference was significant in Ivoclar composites company, but this difference was not significant in Voco composites company.

The reasons of similarity in the surface roughness in bulk fill composites and Voco conventional company before and after the Toothbrushing Test, was the similarity of their chemical formula, the same filler volume (0.08) and the filler material. However, the size of the filler particles in the Grandio conventional composite is slightly smaller than the X-tra bulk fill conventional composite, which, however, is slightly different in their superficial violence, which is not statistically

significant. n examining the weight of composite specimens before and after the Toothbrushing Test, the results showed that the weight of the specimens decreased after brushing the tooth and this weight loss was higher in Tetric N ceram and Tetric N ceram bulk fill composites and this difference was significantly meaningful. According to the results obtained, the increase in surface roughness leads to the loss of composite mass, and the two are related. Kanter et al. 1982 investigated the relationship between weight loss and increased surface roughness in several composites after a Toothbrushing Test. Their study showed that the relationship between increased surface roughness and weight loss in composite specimens was significant and there was a high correlation between these two variables.

Their study showed that as the fillers used in a composite are smaller and softer, their resistance to abrasion increases (21). Machodo et al. 2010 evaluated the degree of superficial violence and weight loss of denture base materials. In their study, the Lucitone 550 resin had increased superficial violence and weight loss of the resin nets, and the correlation between these two variables was high (31). In general, the results of this study showed that the superficial violence of all studied composites after Toothbrushing Test increased, and this increase was statistically significant. The highest surface roughness and weight loss after the Toothbrushing Test was due to the Tetric N Ceram bulk fill composite, as well as the bulk fill composites, showed a higher surface roughness than conventional ones.

Suggestions for future research: Due to the higher degree of surface roughness in bulk fill composites compared to conventional ones, it is recommended that a final layer of conventional composites be added to abrasion resistance, as well as additional studies in composite bulk fill from different brands.

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